Emission Factors and Energy Prices for Leonardo Academy's Cleaner and Greener® Program

A White Paper by Leonardo Academy Inc.

Prepared For the Multiple Pollutant Emission Reduction Reporting System (MPERRS)

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This is a Leonardo Academy Inc.
White Paper

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Preface

This is the April 21, 2009, working draft of the Leonardo Academy white paper on emission factors and energy prices.

Objectives

This white paper is being prepared and issued as a working draft with several goals in mind:

- To provide emission factors useful for calculating building emission footprints
- To provide emission factors useful for calculating the emissions reduced by buildings' energy use reductions
- To give some background information pertaining to the sources and calculation of the emission factors
- To identify current average energy prices for common forms of energy use in buildings, electricity and natural gas

Please contact Leonardo Academy if you have any questions, comments, or suggestions for this white paper.

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Section 1: Emission Factor Background Discussion

Average All Generation and Non-Baseload Electric Generation Emissions Factors for Pollutants for Each State

Different emissions factors are appropriate for different purposes.

For calculating total emissions caused by a consumer's electricity use, average all generation emission rates are appropriate. Average all generation emissions rates are calculated by dividing the emissions from all generation by the total amount of electricity generated in the state.

For calculating the emission reduction caused by an energy efficiency or renewable energy project, the non-baseload generation only emission rates are appropriate. Non-baseload generation includes only generation from fuel combustion (i.e. does not include wind, nuclear, solar, etc.) from plants that have a capacity factor less than 0.8[1]. Non-baseload generation emissions rates are calculated by dividing the emissions from the non-baseload generation by the amount of electricity generated by non-baseload generation in the state[2]. Leonardo Academy believes that non-baseload fuel-powered generation emission factors provide more accurate estimates of emission reductions from energy efficiency. This is because low operating cost generation systems powered by non-fuel resources such as wind and solar will run whenever they are available, regardless of decreases in overall energy consumption. Additionally, the output of baseload plants, such as coal and nuclear, is unlikely to be affected by reduced demand by a single consumer, as such plants operate most cost-effectively at capacity and are not easily adjusted to meet peaking power needs. The non-baseload fuel-powered generation emission rates, however, capture the operations that are most likely to adjust to meet demand, the operations most likely to reduce their output when consumer energy consumption is reduced.

How location specific should electric generation emissions factors be?

Another issue in selecting emissions factors is how location specific to make them. Because of the interconnected nature of the electric transmission and generation system, it is uncertain where the electricity used by a specific customer is actually generated. For this reason, using some kind of regional average is appropriate. Since it is likely that much of the electricity used by a consumer is produced relatively nearby, it is reasonable to use emission factors that reflect the generation mix in various regions of the country. Using emissions factors for each state or for regions that include several states is probably a reasonable compromise. Also, because many regulatory programs are implemented through State Implementation Plans, using state-based emission factors makes sense.

Using emission factors calculated based on areas smaller than a state probably does not improve the accuracy of emissions reduction estimates due to the uncertainty of where the electricity being used was actually generated. In unusual circumstances such as off grid, isolated generation and customer

[1] A plant's capacity factor is determined by dividing the actual annual net generation of a plant by the generation of the plant had it operated at full capacity (nameplate capacity) for the entire year. A plant with a capacity factor of 0.8 operates on average at 80% of its capacity.

[2] The quantity of non-baseload generation was determined by weighting the generation at each plant according to its capacity factor. All generation at plants with capacity factors between 0.0 and 0.2 was considered to be non-baseload. A percentage of the generation of plants with capacity factors between 0.2 and 0.8 was determined to be non-baseload, with 0.2 at 100%, 0.8 at 0%, and the percentage of non-baseload generation for plants with intermediate capacity factors was determined by a linear relationship between the two. Each plant's total emissions were multiplied by its percent non-baseload generation to determine its non-baseload emissions.

groups, site-specific emission factors would be appropriate. In some locations, particularly in states where a large volume of electricity is imported or exported, it may be preferable to use factors associated with the larger eGRID subregions or the even larger NERC regions. For this reason, this report includes state, eGRID subregion, and NERC region level emission factors. Maps of the eGRID subregion and NERC region divisions can be found at http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2007_eGRID_subregions.jpg and http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2007_NERC_regions.jpg respectively.

Leonardo Academy developed what we thought were accurate emission factors for electricity emissions for our Multiple Pollutant Emission Reduction Reporting System (MPERRS) project. This project used different emission factors than those recommended by the U.S. DOE EIA for 1605(b) reporting, in order to account for emission reductions from energy efficiency and renewable energy projects.

In the end, the final decision on what are the appropriate emission factors for reporters of emissions reductions will be made by the U.S. EPA and state EPAs, with input from other affected parties. This will happen when emission reduction reporting moves from a voluntary to a regulator-specified system, as each pollutant is included in a regulator-mandated trading program.

Emission Factor Methodology

In summary, the emission factors were calculated as follows.

The emission factors for CO_2, CH_4, N_2O, SO_2, NO_x, and Hg emissions in Tables 2-1 through 2-6 were taken directly from the U.S. EPA's Emissions & Generation Resource Integrated Database's (eGRID) MS-Excel Aggregation workbook[3] and converted to pounds per kilowatt-hour. eGRID2007 version 1.1 provides emissions and generation information for different strata of the power system using data from the year 2005. eGRID2007 data can be aggregated by power plant, generating company, parent company, state, power control area, eGRID subregion, NERC region, or United States total.

eGRID calculated state average annual output emission rates (lbs/MWh or lbs/GWh) for the year 2005 by dividing annual net generation by state by annual emissions by pollutant type. eGRID calculated state non-baseload annual output emission rates (lbs/MWh or lbs/GWh) for 2005 by dividing annual non-baseload net generation by state by non-baseload annual emissions by pollutant type. Emission rates by eGRID subregion and NERC region were calculated in a similar fashion.

Because eGRID's output emission rates (lbs/MWh or lbs/GWh) are at the generation source level, but are applied at the retail source level (i.e., by assigning emissions to usage by retail customers) for the purposes of Leonardo Academy's Cleaner and Greener® Program, emission factors were revised upwards by a factor of 5.9% to reflect transmission and distribution line losses. This factor was determined by comparing total consumption to total generation in the U.S. for 2005[4].

[3] U.S. EPA eGRID2007 Version 1.1 Year 2005 eGRID State, EGC Location (operator)-based, EGC Owner-based, Parent Company Location (operator)-based, Parent Company Owner-based, PCA, eGRID Subregion, NERC Region, and U.S. Data Files, Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

[4] U.S. EPA eGRID2007 Version 1.1 U.S Generation and Consumption File (Years 2005 and 2004 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

Imports and exports of electricity were not considered in the emission factors compiled in Tables 2-1 through 2-6 in this reporting guide. Though eGRID does provide quantities of electricity imported and exported for each state, there is too much uncertainty within eGRID regarding where imports originated and where exports were going. Because electricity flows are not usually measured on state, eGRID subregion, or NERC region borders, net imports and exports in eGRID at each of these levels are estimated indirectly. Thus, all net imports values reported in eGRID are estimates rather than measured values. Also, there is the added uncertainty of the actual generation mix of imports and exports. Due to this uncertainty, it was determined that the possible increased accuracy to the emission factors does not justify the additional workload necessary to incorporate imports and exports into the model. Also, State Implementation Plans are only interested at looking at emissions that are emitted within a given state and are not concerned with state imports or exports.

Emission factors for the different fuel types listed in Section 3 were calculated using US EPA Document AP 42[5].

[5] U.S. EPA Office of Air Quality Planning & Standards, AP 42 Fifth Edition: Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Website (http://www.epa.gov/ttn/chief/ap42/index.html)

Section 2: Electricity Emission Factors

Average All Generation Electricity Emission Factors

Tables 2-1 through 2-3 below contain electricity emission factors by state, eGRID subregion, and NERC region for the calculation of emissions footprints. While state-level emission factors are appropriate in most cases, as delineated above, buildings located in states with substantial imports or exports of electricity may find eGRID subregion- or NERC region-level factors to be more suitable.

Table 2-1: State-level all generation electricity emission factors for the calculation of emission footprints (Annual output emission rates, including 5.9% transmission and distribution loss)[6,7]

State	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
Alabama	1.420	2.658E-05	2.445E-05	0.007190	0.002133	4.215E-08
Alaska	1.154	2.611E-05	6.391E-06	0.001144	0.003513	1.800E-09
Arizona	1.227	1.645E-05	1.687E-05	0.001111	0.001711	1.567E-08
Arkansas	1.302	3.386E-05	2.362E-05	0.003152	0.001684	2.256E-08
California	0.572	3.241E-05	4.763E-06	0.000144	0.000236	2.118E-09
Colorado	2.024	2.486E-05	3.099E-05	0.002684	0.003095	1.737E-08
Connecticut	0.851	7.179E-05	1.443E-05	0.000579	0.000637	1.673E-08
Delaware	2.137	3.865E-05	2.808E-05	0.008469	0.003526	4.215E-08
District of Columbia	2.576	1.112E-04	2.223E-05	0.008567	0.003869	NA
Florida	1.420	4.842E-05	1.872E-05	0.004117	0.002239	1.101E-08
Georgia	1.485	2.332E-05	2.534E-05	0.010015	0.001837	2.902E-08
Hawaii	1.833	1.752E-04	3.173E-05	0.004413	0.004109	1.228E-08
Idaho	0.142	2.029E-05	3.639E-06	0.000186	0.000148	NA
Illinois	1.192	1.392E-05	1.959E-05	0.003826	0.001451	4.522E-08
Indiana	2.211	2.599E-05	3.681E-05	0.014251	0.003483	4.766E-08
Iowa	2.020	2.370E-05	3.348E-05	0.006641	0.003648	5.348E-08
Kansas	2.007	2.462E-05	3.316E-05	0.006305	0.004155	4.702E-08
Kentucky	2.179	2.556E-05	3.697E-05	0.010908	0.003628	3.971E-08
Louisiana	1.245	2.695E-05	1.421E-05	0.002616	0.001726	1.345E-08
Maine	0.783	2.425E-04	3.441E-05	0.001294	0.001088	2.965E-09
Maryland	1.432	3.662E-05	2.407E-05	0.011583	0.002607	4.109E-08
Massachusetts	1.337	7.245E-05	1.825E-05	0.003732	0.001175	1.578E-08
Michigan	1.427	3.140E-05	2.505E-05	0.006799	0.002204	3.283E-08
Minnesota	1.689	4.100E-05	3.017E-05	0.004226	0.003542	3.061E-08
Mississippi	1.298	2.805E-05	1.845E-05	0.003630	0.002076	1.387E-08
Missouri	1.956	2.256E-05	3.252E-05	0.006878	0.002996	4.543E-08
Montana	1.686	2.089E-05	2.880E-05	0.001650	0.003093	3.834E-08

[6] U.S. EPA eGRID2007 Version 1.1 State File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

[7] U.S. EPA eGRID2007 Version 1.1 United States File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

Table 2-1: State-level all generation electricity emission factors for the calculation of emission footprints (Annual output emission rates, including 5.9% transmission and distribution loss)[6,7]

State	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
Nebraska	1.701	1.967E-05	2.827E-05	0.004995	0.003643	2.351E-08
Nevada	1.526	2.120E-05	1.890E-05	0.002772	0.002377	1.578E-08
New Hampshire	0.835	6.460E-05	1.589E-05	0.004791	0.000997	2.648E-09
New Jersey	0.761	3.200E-05	1.142E-05	0.002034	0.001044	1.398E-08
New Mexico	2.050	2.465E-05	3.233E-05	0.001849	0.004600	6.767E-08
New York	0.877	3.914E-05	1.102E-05	0.002598	0.000939	1.165E-08
North Carolina	1.297	2.099E-05	2.257E-05	0.008333	0.001889	2.870E-08
North Dakota	2.462	2.658E-05	3.956E-05	0.009212	0.005113	7.572E-08
Ohio	1.876	2.223E-05	3.167E-05	0.015062	0.003513	5.104E-08
Oklahoma	1.655	2.294E-05	2.165E-05	0.003277	0.002629	2.933E-08
Oregon	0.425	1.797E-05	5.085E-06	0.000553	0.000471	3.812E-09
Pennsylvania	1.318	2.692E-05	2.217E-05	0.009688	0.001791	5.168E-08
Rhode Island	1.022	2.035E-05	2.092E-06	0.000058	0.000225	NA
South Carolina	0.947	1.580E-05	1.607E-05	0.004673	0.001149	1.260E-08
South Dakota	1.251	1.479E-05	2.016E-05	0.003722	0.004807	1.504E-08
Tennessee	1.333	1.738E-05	2.297E-05	0.005852	0.002258	3.008E-08
Texas	1.435	2.091E-05	1.626E-05	0.003185	0.001045	2.595E-08
Utah	2.227	2.557E-05	3.727E-05	0.002054	0.003929	8.048E-09
Vermont	0.005	9.384E-05	1.253E-05	0.000018	0.000215	NA
Virginia	1.267	4.341E-05	2.252E-05	0.006104	0.001895	1.684E-08
Washington	0.351	1.737E-05	6.399E-06	0.000094	0.000449	6.989E-09
West Virginia	2.042	2.319E-05	3.465E-05	0.010683	0.003673	5.666E-08
Wisconsin	1.822	2.703E-05	2.995E-05	0.006506	0.002547	3.939E-08
Wyoming	2.384	2.720E-05	3.943E-05	0.004196	0.004248	4.310E-08
US Average	1.408	2.888E-05	2.182E-05	0.005569	0.002051	2.880E-08

Table 2-2: eGRID subregion-level all generation electricity emission factors for the calculation of emission footprints (Annual output emission rates, including 5.9% transmission and distribution loss)[8,9]

Subregion Acronym	Subregion Name	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
AKGD	ASCC Alaska Grid	1.305	2.711E-05	6.891E-06	0.001285	0.002626	2.224E-09
AKMS	ASCC Miscellaneous	0.528	2.198E-05	4.318E-06	0.000557	0.007191	NA
ERCT	ERCOT All	1.402	1.975E-05	1.601E-05	0.003384	0.000928	2.605E-08
FRCC	FRCC All	1.396	4.863E-05	1.794E-05	0.003789	0.002195	9.743E-09
HIMS	HICC Miscellaneous	1.604	3.332E-04	4.965E-05	0.006028	0.007761	NA
HIOA	HICC Oahu	1.919	1.159E-04	2.501E-05	0.003808	0.002741	1.684E-08
MROE	MRO East	1.943	2.922E-05	3.215E-05	0.007589	0.002909	2.902E-08
MROW	MRO West	1.929	2.965E-05	3.252E-05	0.005981	0.003933	4.342E-08
NYLI	NPCC Long Island	1.627	1.222E-04	1.916E-05	0.003973	0.001735	5.825E-09
NEWE	NPCC New England	0.982	9.160E-05	1.801E-05	0.002498	0.000914	1.059E-08
NYCW	NPCC NYC/Westchester	0.864	3.815E-05	5.778E-06	0.000633	0.000772	6.248E-09
NYUP	NPCC Upstate NY	0.763	2.628E-05	1.185E-05	0.003178	0.000881	1.483E-08
RFCE	RFC East	1.206	3.206E-05	1.982E-05	0.008252	0.001727	4.098E-08
RFCM	RFC Michigan	1.656	3.593E-05	2.877E-05	0.007837	0.002483	3.918E-08
RFCW	RFC West	1.629	1.931E-05	2.723E-05	0.010362	0.002733	4.691E-08
SRMW	SERC Midwest	1.939	2.239E-05	3.230E-05	0.006792	0.002378	4.829E-08
SRMV	SERC Mississippi Valley	1.080	2.575E-05	1.240E-05	0.001916	0.001315	1.059E-08
SRSO	SERC South	1.577	2.782E-05	2.697E-05	0.009398	0.002183	3.770E-08
SRTV	SERC Tennessee Valley	1.600	2.123E-05	2.715E-05	0.007137	0.002628	2.965E-08
SRVC	SERC Virginia/Carolina	1.202	2.517E-05	2.096E-05	0.006233	0.001700	2.309E-08
SPNO	SPP North	2.077	2.522E-05	3.398E-05	0.007053	0.004072	4.469E-08
SPSO	SPP South	1.756	2.645E-05	2.394E-05	0.003680	0.002509	3.283E-08
CAMX	WECC California	0.767	3.202E-05	8.552E-06	0.000562	0.000654	4.342E-09
NWPP	WECC Northwest	0.955	2.026E-05	1.578E-05	0.001310	0.001683	1.430E-08
RMPA	WECC Rockies	1.994	2.423E-05	3.045E-05	0.002458	0.002979	1.970E-08
AZNM	WECC Southwest	1.388	1.848E-05	1.899E-05	0.001144	0.002236	2.584E-08
US Average		1.408	2.888E-05	2.182E-05	0.005569	0.002051	2.880E-08

[8] U.S. EPA eGRID2007 Version 1.1 Subregion Location (Operator)-based File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

[9] U.S. EPA eGRID2007 Version 1.1 United States File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

Table 2-3: NERC region-level all generation electricity emission factors for the calculation of emission footprints (Annual output emission rates, including 5.9% transmission and distribution loss)[10,11]

NERC Region Acronym	NERC Region Name	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
ASCC	Alaska Systems Coordinating Council	1.154	2.611E-05	6.391E-06	0.001144	0.003513	1.800E-09
FRCC	Florida Reliability Coordinating Council	1.396	4.863E-05	1.794E-05	0.003789	0.002195	9.743E-09
HICC	Hawaiian Islands Coordinating Council	1.833	1.752E-04	3.173E-05	0.004413	0.004109	1.228E-08
MRO	Midwest Reliability Organization	1.931	2.959E-05	3.247E-05	0.006211	0.003786	4.141E-08
NPCC	Northeast Power Coordinating Council	0.927	6.413E-05	1.435E-05	0.002550	0.000927	1.112E-08
RFC	Reliability First Corporation	1.511	2.456E-05	2.528E-05	0.009515	0.002423	4.448E-08
SERC	SERC Reliability Corporation	1.450	2.469E-05	2.387E-05	0.006613	0.002040	2.933E-08
SPP	Southwest Power Pool	1.855	2.607E-05	2.703E-05	0.004718	0.002991	3.643E-08
TRE	Texas Regional Entity	1.402	1.975E-05	1.601E-05	0.003384	0.000928	2.605E-08
WECC	Western Electricity Coordinating Council	1.094	2.395E-05	1.564E-05	0.001147	0.001608	1.430E-08
US Average		1.408	2.888E-05	2.182E-05	0.005569	0.002051	2.880E-08

[10] U.S. EPA eGRID2007 Version 1.1 NERC Region Location (Operator)-based File (Year 2005 Data). Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)
[11] U.S. EPA eGRID2007 Version 1.1 United States File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

Non-Baseload Electricity Emission Factors

Tables 2-4 through 2-6 below contain emission factors for non-baseload electricity use, appropriate for determining emissions reductions from energy efficiency and renewable energy. Again, factors are provided at the state, eGRID subregion, and NERC region levels.

Table 2-4: State-level non-baseload electricity emission factors for the calculation of emission reduction benefits from energy efficiency and renewable energy (Annual non-baseload output emission rates, including 5.9% transmission and distribution loss)[12,13]

State	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
Alabama	1.825	4.372E-05	2.990E-05	0.010284	0.002872	4.120E-08
Alaska	1.557	4.303E-05	9.397E-06	0.002689	0.006407	0.000E+00
Arizona	1.245	2.122E-05	9.948E-06	0.000876	0.000989	1.006E-08
Arkansas	1.665	4.840E-05	2.560E-05	0.003456	0.001924	2.277E-08
California	1.124	4.234E-05	5.194E-06	0.000057	0.000298	2.118E-09
Colorado	1.701	2.341E-05	2.155E-05	0.002131	0.002106	1.228E-08
Connecticut	1.566	8.226E-05	1.840E-05	0.001448	0.001220	1.186E-08
Delaware	2.063	4.154E-05	2.475E-05	0.007236	0.003288	3.431E-08
District of Columbia	2.576	1.112E-04	2.223E-05	0.008567	0.003869	NA
Florida	1.465	5.026E-05	1.487E-05	0.004018	0.002051	6.036E-09
Georgia	1.752	3.514E-05	2.640E-05	0.011543	0.002455	2.362E-08
Hawaii	1.907	1.966E-04	3.176E-05	0.004509	0.005643	1.313E-08
Idaho	0.692	7.637E-05	1.462E-05	0.000863	0.000551	NA
Illinois	2.221	2.701E-05	3.471E-05	0.007610	0.002935	8.599E-08
Indiana	2.246	2.706E-05	3.593E-05	0.016145	0.003795	4.458E-08
Iowa	2.372	2.876E-05	3.828E-05	0.007404	0.004331	5.602E-08
Kansas	2.490	3.942E-05	3.662E-05	0.009451	0.005946	3.887E-08
Kentucky	2.238	2.720E-05	3.739E-05	0.012593	0.003706	3.971E-08
Louisiana	1.371	2.916E-05	1.061E-05	0.002069	0.001923	7.519E-09
Maine	1.336	2.796E-04	3.943E-05	0.002777	0.001492	1.483E-09
Maryland	2.080	5.316E-05	3.292E-05	0.018203	0.003977	5.930E-08
Massachusetts	1.372	4.759E-05	1.321E-05	0.003497	0.000998	8.048E-09
Michigan	1.798	3.134E-05	2.852E-05	0.007803	0.002543	3.791E-08
Minnesota	2.227	7.704E-05	3.890E-05	0.006361	0.005433	3.018E-08
Mississippi	1.561	3.100E-05	1.786E-05	0.004531	0.002803	1.303E-08
Missouri	2.152	2.652E-05	3.310E-05	0.008387	0.003980	3.579E-08
Montana	2.924	7.969E-05	5.332E-05	0.006489	0.003678	3.399E-08
Nebraska	2.301	3.074E-05	3.123E-05	0.006289	0.004968	3.738E-08
Nevada	1.328	2.338E-05	7.685E-06	0.000921	0.001410	6.248E-09

[12] U.S. EPA eGRID2007 Version 1.1 State File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)
[13] U.S. EPA eGRID2007 Version 1.1 United States File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

Table 2-4: State-level non-baseload electricity emission factors for the calculation of emission reduction benefits from energy efficiency and renewable energy (Annual non-baseload output emission rates, including 5.9% transmission and distribution loss)[12,13]

State	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
New Hampshire	1.443	6.697E-05	1.677E-05	0.006633	0.001369	2.224E-09
New Jersey	1.551	3.751E-05	1.804E-05	0.004807	0.002295	1.980E-08
New Mexico	1.568	2.631E-05	1.102E-05	0.000681	0.002678	2.044E-08
New York	1.607	5.505E-05	1.464E-05	0.004693	0.001719	1.303E-08
North Carolina	2.067	3.156E-05	3.326E-05	0.012334	0.003286	4.617E-08
North Dakota	2.657	4.342E-05	4.418E-05	0.011349	0.006047	8.419E-08
Ohio	2.106	2.560E-05	3.440E-05	0.021932	0.004103	6.470E-08
Oklahoma	1.370	2.284E-05	1.068E-05	0.001442	0.002187	1.144E-08
Oregon	1.059	4.497E-05	1.176E-05	0.001203	0.001059	6.989E-09
Pennsylvania	1.954	3.668E-05	2.723E-05	0.013160	0.002741	5.570E-08
Rhode Island	1.115	2.239E-05	2.328E-06	0.000085	0.000337	NA
South Carolina	1.865	3.003E-05	2.684E-05	0.008157	0.002022	2.213E-08
South Dakota	2.356	3.123E-05	3.166E-05	0.005873	0.007408	1.684E-08
Tennessee	2.172	2.797E-05	3.705E-05	0.011673	0.003854	5.592E-08
Texas	1.206	2.193E-05	6.174E-06	0.000661	0.000705	4.660E-09
Utah	1.947	2.591E-05	2.632E-05	0.003078	0.004665	7.731E-09
Vermont	0.184	1.076E-03	1.441E-04	0.000192	0.002893	NA
Virginia	1.708	5.839E-05	2.583E-05	0.009286	0.002442	2.393E-08
Washington	1.314	7.578E-05	2.262E-05	0.000406	0.001503	2.065E-08
West Virginia	2.082	2.385E-05	3.505E-05	0.014296	0.004480	6.428E-08
Wisconsin	1.895	3.848E-05	2.672E-05	0.005853	0.002681	2.425E-08
Wyoming	2.268	2.752E-05	3.543E-05	0.002719	0.004299	3.908E-08
US Average	1.677	3.789E-05	2.115E-05	0.006495	0.002343	2.573E-08

Table 2-5: eGRID subregion-level non-baseload electricity emission factors for the calculation of emission reduction benefits from energy efficiency and renewable energy (Annual non-baseload output emission rates, including 5.9% transmission and distribution loss)[14,15]

Subregion Acronym	Subregion Name	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
AKGD	ASCC Alaska Grid	1.560	3.856E-05	8.721E-06	0.002914	0.003258	0.000E+00
AKMS	ASCC Miscellaneous	1.543	6.404E-05	1.257E-05	0.001637	0.021191	NA
ERCT	ERCOT All	1.185	2.134E-05	6.010E-06	0.000642	0.000609	4.448E-09
FRCC	FRCC All	1.434	5.100E-05	1.372E-05	0.003599	0.001979	4.130E-09
HIMS	HICC Miscellaneous	1.773	3.584E-04	5.445E-05	0.004777	0.011204	NA
HIOA	HICC Oahu	1.965	1.272E-04	2.201E-05	0.004394	0.003255	1.874E-08
MROE	MRO East	1.937	3.053E-05	2.668E-05	0.007182	0.003076	1.927E-08
MROW	MRO West	2.286	4.826E-05	3.730E-05	0.006953	0.004778	4.511E-08
NYLI	NPCC Long Island	1.599	6.388E-05	1.142E-05	0.003971	0.001638	5.295E-10
NEWE	NPCC New England	1.392	8.204E-05	1.697E-05	0.003102	0.001092	6.884E-09
NYCW	NPCC NYC/Westchester	1.615	6.015E-05	9.618E-06	0.001302	0.001482	5.189E-09
NYUP	NPCC Upstate NY	1.603	4.798E-05	1.949E-05	0.007443	0.001924	2.319E-08
RFCE	RFC East	1.896	4.406E-05	2.579E-05	0.011147	0.002931	4.490E-08
RFCM	RFC Michigan	1.761	3.113E-05	2.779E-05	0.007527	0.002392	3.802E-08
RFCW	RFC West	2.110	2.593E-05	3.359E-05	0.015140	0.003637	6.407E-08
SRMW	SERC Midwest	2.225	2.717E-05	3.486E-05	0.009327	0.003351	4.490E-08
SRMV	SERC Mississippi Valley	1.331	3.124E-05	1.040E-05	0.001879	0.001757	7.201E-09
SRSO	SERC South	1.797	3.727E-05	2.797E-05	0.010999	0.002752	3.135E-08
SRTV	SERC Tennessee Valley	2.116	2.991E-05	3.480E-05	0.010703	0.003488	4.194E-08
SRVC	SERC Virginia/Carolina	1.886	4.245E-05	2.908E-05	0.009882	0.002635	3.325E-08
SPNO	SPP North	2.298	3.302E-05	3.388E-05	0.009190	0.004671	3.707E-08
SPSO	SPP South	1.460	2.584E-05	1.276E-05	0.001802	0.002083	1.250E-08
CAMX	WECC California	1.147	4.156E-05	5.878E-06	0.000249	0.000379	3.283E-09
NWPP	WECC Northwest	1.412	5.219E-05	1.983E-05	0.001358	0.002227	1.356E-08
RMPA	WECC Rockies	1.713	2.375E-05	2.132E-05	0.002161	0.002160	1.260E-08
AZNM	WECC Southwest	1.272	2.203E-05	9.006E-06	0.000684	0.001105	9.531E-09
US Average		1.677	3.789E-05	2.115E-05	0.006495	0.002343	2.573E-08

[14] U.S. EPA eGRID2007 Version 1.1 Subregion Location(Operator)-based File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)
[15] U.S. EPA eGRID2007 Version 1.1 United States File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

Table 2-6: NERC region-level non-baseload electricity emission factors for the calculation of emission reduction benefits from energy efficiency and renewable energy (Annual non-baseload output emission rates, including 5.9% transmission and distribution loss) [16,17]

NERC Region Acronym	NERC Region Name	CO_2 lbs/kWh	CH_4 lbs/kWh	N_2O lbs/kWh	SO_2 lbs/kWh	NO_x lbs/kWh	Hg lbs/kWh
ASCC	Alaska Systems Coordinating Council	1.557	4.303E-05	9.397E-06	0.002689	0.006407	0.000E+00
FRCC	Florida Reliability Coordinating Council	1.434	5.100E-05	1.372E-05	0.003599	0.001979	4.130E-09
HICC	Hawaiian Islands Coordinating Council	1.907	1.966E-04	3.176E-05	0.004509	0.005643	1.313E-08
MRO	Midwest Reliability Organization	2.216	4.470E-05	3.518E-05	0.006999	0.004437	3.992E-08
NPCC	Northeast Power Coordinating Council	1.497	6.884E-05	1.582E-05	0.003877	0.001398	9.849E-09
RFC	Reliability First Corporation	1.994	3.212E-05	3.039E-05	0.012803	0.003239	5.443E-08
SERC	SERC Reliability Corporation	1.829	3.427E-05	2.655E-05	0.008484	0.002737	3.018E-08
SPP	Southwest Power Pool	1.652	2.749E-05	1.760E-05	0.003495	0.002676	1.811E-08
TRE	Texas Regional Entity	1.185	2.134E-05	6.010E-06	0.000642	0.000609	4.448E-09
WECC	Western Electricity Coordinating Council	1.290	3.522E-05	1.083E-05	0.000773	0.001110	7.943E-09
US Average		1.677	3.789E-05	2.115E-05	0.006495	0.002343	2.573E-08

[16] U.S. EPA eGRID2007 Version 1.1 NERC Region Location (Operator)-based File (Year 2005 Data). Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)
[17] U.S. EPA eGRID2007 Version 1.1 United States File (Year 2005 Data), Released January 2009. (http://www.epa.gov/cleanenergy/egrid/index.htm)

Section 3: Building Fuels Emission Factors

Notes on emission factors for different fuel types:
Emission levels for most emission types depend mainly upon the type of fuel that is being consumed. Burning coal will release more CO_2 and SO_2 into the atmosphere than will burning natural gas, for example. NO_x and VOC emissions, on the other hand, are much more dependent on the combustion source and technology type or equipment used than the other emission types. Different end use appliances can release very different amounts of NO_x and VOC emissions for the same amount of fuel used for each unit.

The NO_x, CO, and VOC emission factors used for natural gas in this reporting guide provide a good estimation for emission levels. However, better accuracy will always be obtained by using more specific emission factors consistent with your specific project. The U.S. EPA has been performing emissions testing on many end use equipment types in recent years through their AP-42 Project. Reporters may be able to find emission factors for their specific project equipment through the AP-42 web site (http://www.epa.gov/ttn/chief/ap42/ap42supp.html). Where applicable, reporters should use the regulatory specified approach for determining the appropriate emission factor to use for their reporting. Care should be exercised for smaller sources not covered under the regulatory specified approach, in order to be consistent and to provide the best available emission factors to meet your combustion source and technology type.

Tables 3-1 through 3-4 below present emission factors for a variety of emissions for fuels commonly used in buildings.

Table 3-1: Emission Factors for Natural Gas[18]

Emission Type	Emission Factor		
	lbs per million Btu	lbs per 1000 ft^3	lbs per Therm
CO_2	117.6	120	11.76
CH_4	0.0225	0.023	0.0023
N_2O	0.0022	0.0022	0.0002
SO_2	0.0006	0.0006	0.00006
NO_x (residential furnace)[19]	0.0922	0.094	0.0092
NO_x (small boiler)[20]	0.0980	0.1	0.0098
CO (residential furnace)[8]	0.0392	0.04	0.0039
CO (small boiler)[9]	0.0824	0.084	0.0082
PM_{10}	0.00186	0.0019	0.000186
VOC	0.0054	0.0055	0.00054
Hg	2.5E-07	2.6E-07	2.5E-08

Conversion: 1.02 MMBtu / 1000 ft^3

[18] U.S. EPA Office of Air Quality Planning & Standards, AP 42 Chapter 1.4, Updated July 1998, Website (http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf)
[19] Residential furnace factors for NO_x and CO are for home furnaces without NO_x controls.
[20] Small boiler factors for NO_x and CO are for boilers with less than 100 MMBtu/hour heat input without NO_x controls.

Table 3-2: Emission Factors for Propane[21]

Emission Type	lbs/gallon	lbs/million Btu
CO_2	12.5	136.6
CH_4	0.0002	0.0022
N_2O	0.0009	0.0098
NO_x	0.013	0.14
SO_2*	0.00010S	0.0011S
PM-filterable	0.0002	0.0022
PM-condensable	0.0005	0.0055
VOC(TOC)	0.0010	0.011
CO	0.0075	0.082
Hg	0/negligible	0/negligible

Conversion: 0.0915 MMBtu/gallon

Table 3-3: Emission Factors for Butane[10]

Emission Type	lbs/gallon	lbs/million Btu
CO_2	14.3	140.2
CH_4	0.0002	.0020
N_2O	0.0009	0.0088
NO_x	0.015	0.147
SO_2*	0.00009S	0.00088S
PM-filterable	0.0002	0.0020
PM-condensable	0.0006	.0059
VOC(TOC)	0.0011	0.0108
CO	0.0084	0.0824
Hg	0/negligible	0/negligible

Conversion: 0.102 MMBtu/gallon

* For SO_2 emission factors for propane and butane, S equals the sulfur content expressed in gr/100 ft^3 gas vapor. For example, if the butane sulfur content is 0.18 gr/100 ft^3, the emission factor would be (0.00009 x 0.18) = 0.0000162 lb of SO_2/gal butane burned.

[21] U.S. EPA Office of Air Quality Planning & Standards, AP 42 Chapter 1.5, Updated July 2008, Website (http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s05.pdf)

Table 3-4: Emission Factors for Residual & Distillate Fuels[22]

Emission Type	No. 6 oil		No. 4 oil		Residential	
	lbs/gal	lbs/MMBtu	lbs/gal	lbs/MMBtu	lbs/gal	lbs/MMBtu
CO_2	25	167	25	167	21.5	154
CH_4	0.000475	0.00317	0.000216	0.00144	0.00178	0.0127
N_2O	0.00011	0.00073	0.00011	0.00073	0.00005	0.0004
NO_x	0.055	0.37	0.02	0.13	0.018	0.13
SO_2*	0.157S	1.05S	0.15S	1.0S	0.142S	1.01S
PM-filterable	0.01	0.07	0.007	0.05	0.0004	0.003
VOC(NMTOC)	0.00113	0.00753	0.00034	0.0023	0.000713	0.00509
CO	0.005	0.03	0.005	0.03	0.005	0.04
Hg	1.13E-07	7.53E-07	1.13E-07	7.53E-07	3E-06	2E-05

Conversion: 0.15 MMBtu/gallon for Nos. 4 & 6; 0.14 MMBtu/gallon for residential.
*****S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S=1.

In Table 3-4 above, the NO_x, SO_2, PM, VOC, & CO factors assume use in boilers generating less than 100 million Btu per hour. The CH_4 and NMTOC factors assume use in commercial, institutional, or residential combustors. Utility and industrial boilers and boilers putting out greater than 100 million Btu/hr should reference AP-42 Tables 1.3-1 and 1.3-3 for appropriate factors.

[22] U.S. EPA Office of Air Quality Planning & Standards, AP 42 Chapter 1.3, Updated September 1998, Website (http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s03.pdf)

Section 4: Energy Prices

The following tables (4-1 – 4-4) show the average energy prices during the majority of 2008 of both electricity and natural gas for residential, commercial, and industrial consumers.

Table 4-1: Average Price of Electricity to End Customers, by Sector and State, January - October 2008[23]

State	Residential (cents/kWh)	Commercial (cents/kWh)	Industrial (cents/kWh)
Alabama	10.24	9.7	6.02
Alaska	16.35	13.14	14.26
Arizona	10.35	8.95	6.69
Arkansas	9.49	7.73	5.98
California	14.37	13.12	10.28
Colorado	10.17	8.65	6.63
Connecticut	19.29	15.96	13.8
Delaware	13.88	12.04	10.25
District of Columbia	12.64	13.76	11.55
Florida	11.6	10.06	8.27
Georgia	10.14	9.18	6.69
Hawaii	32.73	29.97	26.33
Idaho	6.97	5.67	4.55
Illinois	10.82	8.78	N/A
Indiana	8.76	7.67	5.49
Iowa	9.66	7.24	4.9
Kansas	9.17	7.7	N/A
Kentucky	7.71	7.12	4.84
Louisiana	10.55	10.29	8.12
Maine	15.98	12.99	11.88
Maryland	13.67	12.79	10.46
Massachusetts	17.38	16.1	14.41
Michigan	10.88	9.42	6.87
Minnesota	9.61	7.82	5.99
Mississippi	10.34	9.96	6.46
Missouri	8.01	6.6	4.98
Montana	9.16	8.48	6.4
Nebraska	7.87	6.59	5.12
Nevada	11.87	10.14	8.23
New Hampshire	15.58	14.2	13.12
New Jersey	16.01	14.9	12.55
New Mexico	10.02	8.65	6.45
New York	18.56	16.96	10.28
North Carolina	9.68	7.64	5.59
North Dakota	7.54	6.74	5.54
Ohio	10.13	9.19	6.19
Oklahoma	9.45	8.21	6.08
Oregon	8.54	7.63	4.93

[23] US DOE/EIA Electric Power Monthly with data for October 2008. Table 5.6.B: Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date Through October 2008 and 2007. Released January 15, 2009 (http://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b.html).

Table 4-1: Average Price of Electricity to End Customers, by Sector and State, January - October 2008[23]

State	Residential (cents/kWh)	Commercial (cents/kWh)	Industrial (cents/kWh)
Pennsylvania	11.47	9.41	7.04
Rhode Island	17.26	15.25	14.08
South Carolina	9.98	8.48	N/A
South Dakota	8.26	6.81	5.31
Tennessee	8.55	8.74	6.14
Texas	12.94	10.8	8.97
Utah	8.37	6.8	4.7
Vermont	14.6	12.5	9.01
Virginia	9.55	7.24	5.54
Washington	7.57	6.73	4.8
West Virginia	7.02	6.02	4.17
Wisconsin	11.44	9.19	6.52
Wyoming	8.16	6.67	4.52
U.S. Total	11.34	10.33	7.01

Table 4-2: Average Price of Natural Gas Delivered to Residential Customers by State, December 2007 - November 2008[24]

State	$ per MCF	$ per MMBtu	$ per therm
Alabama	21.05	21.47	2.147
Alaska	8.73	8.91	0.891
Arizona	19.49	19.87	1.987
Arkansas	17.09	17.44	1.744
California	13.55	13.82	1.382
Colorado	11.24	11.47	1.147
Connecticut	18.95	19.33	1.933
Delaware	18.33	18.70	1.870
District of Columbia	18.48	18.85	1.885
Florida	22.43	22.88	2.288
Georgia	22.32	22.77	2.277
Hawaii	45.57	46.48	4.648
Idaho	11.31	11.54	1.154
Illinois	14.86	15.16	1.516
Indiana	15.25	15.55	1.555
Iowa	14.40	14.69	1.469
Kansas	16.61	16.94	1.694
Kentucky	17.28	17.62	1.762
Louisiana	17.35	17.69	1.769
Maine	18.67	19.04	1.904
Maryland	19.17	19.55	1.955
Massachusetts	18.03	18.39	1.839
Michigan	13.38	13.65	1.365
Minnesota	12.90	13.16	1.316
Mississippi	15.69	16.01	1.601
Missouri	17.88	18.24	1.824
Montana	12.86	13.12	1.312
Nebraska	13.52	13.79	1.379

[24] U.S. DOE/EIA Natural Gas Prices (Dollars per Thousand Cubic Feet). Data Series: Residential Price, Period: Monthly. Released January 31, 2009 (http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_m.htm).

Table 4-2: Average Price of Natural Gas Delivered to Residential Customers by State, December 2007 - November 2008[24]

State	$ per MCF	$ per MMBtu	$ per therm
Nevada	14.42	14.71	1.471
New Hampshire	17.58	17.93	1.793
New Jersey	15.42	15.73	1.573
New Mexico	14.88	15.18	1.518
New York	18.69	19.07	1.907
North Carolina	19.93	20.33	2.033
North Dakota	12.63	12.88	1.288
Ohio	16.37	16.70	1.670
Oklahoma	15.98	16.30	1.630
Oregon	14.26	14.54	1.454
Pennsylvania	18.65	19.03	1.903
Rhode Island	17.70	18.05	1.805
South Carolina	21.78	22.22	2.222
South Dakota	12.75	13.00	1.300
Tennessee	17.53	17.88	1.788
Texas	16.56	16.89	1.689
Utah	9.51	9.70	0.970
Vermont	20.26	20.67	2.067
Virginia	19.40	19.79	1.979
Washington	13.38	13.65	1.365
West Virginia	16.59	16.92	1.692
Wisconsin	14.68	14.97	1.497
Wyoming	11.90	12.13	1.213
U.S. Total	15.43	15.74	1.574

Table 4-3: Average Price of Natural Gas Delivered to Commercial Customers by State, September 2007 - August 2008[25]

State	$ per MCF	$ per MMBtu	$ per therm
Alabama	15.96	16.28	1.628
Alaska	7.48	16.28	1.628
Arizona	13.03	7.63	0.763
Arkansas	11.64	13.29	1.329
California	11.88	11.87	1.187
Colorado	9.21	12.11	1.211
Connecticut	14.21	9.40	0.940
Delaware	14.54	14.49	1.449
District of Columbia	13.68	14.83	1.483
Florida	14.42	13.95	1.395
Georgia	14.60	14.71	1.471
Hawaii	37.13	14.89	1.489
Idaho	10.29	37.87	3.787
Illinois	12.92	10.49	1.049
Indiana	11.76	13.18	1.318
Iowa	10.98	12.00	1.200
Kansas	14.07	11.20	1.120
Kentucky	13.50	14.35	1.435
Louisiana	13.33	13.76	1.376
Maine	15.57	13.60	1.360

[25] U.S. DOE/EIA Natural Gas Prices (Dollars per Thousand Cubic Feet). Data Series: Commercial Price, Period: Monthly. Released January 31, 2009 (http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_m.htm).

Table 4-3: Average Price of Natural Gas Delivered to Commercial Customers by State, September 2007 - August 2008[25]

State	$ per MCF	$ per MMBtu	$ per therm
Maryland	13.35	15.88	1.588
Massachusetts	15.14	13.62	1.362
Michigan	11.05	15.44	1.544
Minnesota	11.18	11.27	1.127
Mississippi	12.44	11.41	1.141
Missouri	12.82	12.68	1.268
Montana	11.90	13.08	1.308
Nebraska	10.20	12.14	1.214
Nevada	11.52	10.41	1.041
New Hampshire	15.31	11.75	1.175
New Jersey	13.88	15.62	1.562
New Mexico	11.21	14.15	1.415
New York	12.76	11.43	1.143
North Carolina	14.34	13.02	1.302
North Dakota	10.25	14.63	1.463
Ohio	13.12	10.46	1.046
Oklahoma	13.27	13.38	1.338
Oregon	11.59	13.53	1.353
Pennsylvania	14.57	11.82	1.182
Rhode Island	16.02	14.87	1.487
South Carolina	14.53	16.34	1.634
South Dakota	10.09	14.82	1.482
Tennessee	13.92	10.30	1.030
Texas	11.58	14.20	1.420
Utah	7.64	11.81	1.181
Vermont	14.14	7.79	0.779
Virginia	13.18	14.43	1.443
Washington	11.44	13.44	1.344
West Virginia	13.98	11.67	1.167
Wisconsin	11.65	14.26	1.426
Wyoming	8.78	11.89	1.189
U.S. Total	12.29	8.96	0.896

Table 4-4: Average Price of Natural Gas Delivered to Industrial Customers by State, December 2007 - November 2008[26]

State	$ per MCF	$ per MMBtu	$ per therm
Alabama	10.59	10.81	1.081
Alaska	5.52	5.63	0.563
Arizona	10.66	10.88	1.088
Arkansas	11.01	11.23	1.123
California	10.93	11.15	1.115
Colorado	8.26	8.43	0.843
Connecticut	12.98	13.24	1.324
Delaware	11.67	11.91	1.191
District of Columbia	N/A	N/A	N/A
Florida	12.61	12.86	1.286
Georgia	11.67	11.91	1.191

[26] U.S. DOE/EIA Natural Gas Prices (Dollars per Thousand Cubic Feet). Data Series: Industrial Price, Period: Monthly. Released January 31, 2009 (http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_a_EPG0_PIN_DMcf_m.htm).

Table 4-4: Average Price of Natural Gas Delivered to Industrial Customers by State, December 2007 - November 2008[26]

State	$ per MCF	$ per MMBtu	$ per therm
Hawaii	26.84	27.37	2.737
Idaho	9.00	9.17	0.917
Illinois	11.07	11.30	1.130
Indiana	10.01	10.21	1.021
Iowa	9.57	9.76	0.976
Kansas	8.99	9.17	0.917
Kentucky	10.59	10.80	1.080
Louisiana	9.50	9.69	0.969
Maine	14.95	15.25	1.525
Maryland	14.14	14.42	1.442
Massachusetts	16.49	16.82	1.682
Michigan	10.67	10.88	1.088
Minnesota	9.43	9.62	0.962
Mississippi	10.40	10.61	1.061
Missouri	11.46	11.69	1.169
Montana	11.89	12.13	1.213
Nebraska	9.41	9.60	0.960
Nevada	10.89	11.11	1.111
New Hampshire	14.63	14.92	1.492
New Jersey	13.27	13.53	1.353
New Mexico	10.00	10.20	1.020
New York	12.92	13.17	1.317
North Carolina	12.39	12.64	1.264
North Dakota	8.62	8.80	0.880
Ohio	13.73	14.00	1.400
Oklahoma	12.08	12.32	1.232
Oregon	8.94	9.12	0.912
Pennsylvania	13.17	13.44	1.344
Rhode Island	13.19	13.45	1.345
South Carolina	11.26	11.49	1.149
South Dakota	9.10	9.28	0.928
Tennessee	10.73	10.95	1.095
Texas	8.92	9.10	0.910
Utah	7.19	7.33	0.733
Vermont	9.75	9.95	0.995
Virginia	11.93	12.17	1.217
Washington	10.44	10.65	1.065
West Virginia	11.02	11.24	1.124
Wisconsin	11.09	11.31	1.131
Wyoming	8.27	8.43	0.843
U.S. Total	9.62	9.81	0.981

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